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Research Article

Comparing the Ease of Endotracheal Intubation with and without an Intubation Box in COVID-19 Patients

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ABSTRACT

Background: Endotracheal intubation is a potentially high-risk aerosol-generating procedure. So, an intubation box (I-Box) is designed for personal protection during intubation. This study aimed to compare the outcomes of endotracheal intubation with and without an I-box in COVID-19 patients.

Methods: In this study, 60 COVID-19 patients (30 patients in each group) with and without I-box groups were included. outcomes of intubation including duration of intubation, first-pass success intubation, suitable visibility of airways, restriction of movement in the neck, the need to surface maneuvering of the airway, and the number of attempts for successful intubation were compared between the two groups.

Results: The time of intubation was significantly longer in the I-box group (15.27±2.6 seconds) than without the I-box group (8.37±1.3 seconds) (p<0.001). All patients (100%) were intubated in the first attempt in the without I-box group while the rate of first-pass success intubation was 50% in the I-box group (p <0.001). The visibility of the airway was significantly better in the without I-box group than the I-box group (without I-box: 23 patients (76.7%), I-box: 15 patients (50%), p= 0.032). The frequency of need to optimizing maneuver of the airway was in without and with I-box was 23.3% and 50% respectively (p=0.032).

Conclusion: However, the I-box as a physical barrier can protect healthcare workers but its use increased the time to intubation and the number of attempts for successful intubation and reduced the rate of first-pass success intubation and visibility.

Introduction

The novel coronavirus disease 2019 (COVID-19), was first detected in December 2019 in Wuhan, China, and World Health Organization (WHO) declared as a pandemic infection in March 2020 [1-2]. COVID-19 is a highly contagious disease that is spread through droplet inhalation or airborne particle transmission [3]. According to the report of WHO on 23 November 2022, the Cumulative cases of COVID-19 patients were 634837882 people and 6601427 people died due to this disease [4].

Healthcare workers (HCWs), especially anesthesiologists and persons who participate in procedures within the head and neck, and airway such as endotracheal intubation and extubation, are at high risk of infection from aerosol and droplets [5-10]. Production of both airborne particles and droplets during aerosol-producing medical procedures may raise HCWs' risk of infection [3].

Endotracheal intubation is a potentially high-risk aerosol-generating procedure for airway managers [8, 11-12]. Therefore, guidelines and methods have been proposed to protect healthcare personnel from spired droplets during endotracheal intubation [1, 12-15]. Personal protective equipment (PPE) must be utilized to protect HCWs during the intubation and extubation of

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COVID-19 patients in the operating room that one such method is the use of an intubation box during intubation [16-18]. In several studies, the different designs provided for this box protect the exposure of HCWs from generated aerosol and droplets as a barrier [19-21].

Few studies have been performed to compare the ease of endotracheal intubation with and without an intubation box [17, 22-24]. Azhar et al showed that an aerosol box increases the intubation time and reduces visibility [22]. A study by Clario et al has shown that the duration of intubation was greater in the box group than without the box [23].

In summary, protecting the HCWs to mitigate exposure risk during aerosol-generating procedures is necessary and on the other hand, performing these procedures is inevitable in COVID-19 patients. Therefore, the current study aimed to compare the ease of endotracheal intubation with and without an intubation box (I-box) in COVID-19 patients.

Methods

This cross-sectional analytic study was approved by the Urmia University of Medical Sciences Ethics Committee under the ID number IR.UMSU.REC.1399.172 and was conducted in the operating rooms and intensive care units (ICU) of Urmia University of Medical Sciences' Imam Khomeini and Motahari teaching hospitals. Based on randomly generated computer numbers, 60 COVID-19 patients were divided into two groups of I-box (30 patients) and without the I-box (30 patients). The inclusion criteria were age >18 years, ASA physical status I-II according to the ASA classification system, and no history of previous difficult intubation; the exclusion criteria were morbid obesity, short and fat neck, long front teeth, and having a long beard and mustache in the patients, difficult intubations, emergency operations, and hemodynamically unstable patients.

In both groups, administration of 100% oxygen called preoxygenation was done before intubation, and after proper sedation, the patient's head was placed in the I-box in I-box group, and endotracheal intubation was performed by the most experienced anesthesiologist. The intubations were performed by different anesthesiologists, but only the most experienced and skilled ones.

Based on the mean and standard deviation of intubation time (27.9±19.3 seconds and 44.6±32.8 seconds in without and with I-Box groups, respectively) in a previous study [25] and with a type 1 error (α) of 5% and a power of 80%, the sample size was calculated 30 patients in each group using the following formula:

$$n = \frac{(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta})^2 \times (S_1^2 + S_2^2)}{(\bar{X}_1 - \bar{X}_2)^2}$$

A questionnaire contains demographic variables (age and sex) and other variables include neck movement restriction, visualization status of the vocal cords and glottis, need for optimization maneuvers, intubation duration (recorded with chronometer), first attempt success, and also the number of attempts for successful intubation was obtained through interviews with the anesthesiologists after each intubation.

Statistical Analysis

Data were presented as mean ± standard deviation (SD) for continuous variables and frequency (percent) for categorical variables. The mean of age and intubation time were compared using Independent T-test between I-box and without I-box groups. The Chi-square test was used for comparing categorical variables between two groups. Data analysis was performed using SPSS17 software and a p-value less than 0.05 was considered as significant level.

Results

In this analytic cross-sectional study, 60 COVID-19 patients (30 patients in each group) in the I-box and without I-box groups were included. There was no difference in patient demographic data between the I-box and without I-box groups (Table 1).

The duration of intubation was longer in the I-box group (15.27±2.6 seconds) than without the I-box group (8.37±1.3 seconds) and this difference was statistically significant between the two groups (p<0.001). In all patients (100%) in the without I-box group the intubation was carried out successfully the first time, while in the I-box group, the intubation was successful in the first attempt in half of the patients (50%) and this difference was significant between two groups (p <0.001). The visibility of the airway was significantly better in the without I-box group than in the I-box group (p=0.032). Motion restriction of the neck was more common in the I-box group than in the without I-box group, but it was not significant between the two groups (p=0.272). Among all patients (100%) in the without I-box group, the intubation was performed in the first attempt while in the I-box group, the frequency of 1st, 2nd and 3rd attempts for intubation was 15 (50%), 11 (36.7%) and 4 (13.3%) respectively. The number of attempts for successful intubation had statistically significant between the two groups (p<0.001). In the without I-box group patients, 76.7% had not to need surface maneuvering for optimization of the airway while this was 50% in the I-box group and this difference was statically significant between the two groups (p= 0.032) (Table 2).

Table 1- Patient demographic

Variables	With I-box	Without I-box	P value
Age (years)	37.7±14.3*	36.2±13.3	0.676
Sex (M/F)	19/11 (63.3%/36.7%)	15/15 (50%/50%)	0.322

*: data are as mean ± SD.

Table 2- The comparison of outcomes in COVID-19 patients between I-box and without I-box groups

Variables		With I-box (n=30)	Without I-box (n=30)	P value#
Intubation time (second)		15.27±2.6	8.37±1.3	<0.001
Successful intubation at first attempt		15 (50%)*	30 (100%)	<0.001
Suitable visibility of airway		15 (50%)	23 (76.7%)	0.032
Restriction of movement in the neck		12 (40%)	8 (26.7%)	0.272
Number of attempts for successful intubation	1	15 (50%)	30 (100%)	<0.001
	2	11 (36.7%)	0	
	3	4 (13.3%)	0	
Need optimization maneuvers		15 (50%)	7 (23.3%)	0.032

#: Compared using chi-square test.
*: data are as numbers (%).

Discussion

Tracheal intubation is one of the aerosol-generating procedures with the greatest risk in COVID-19 patients. Generated droplets increase the risk of infection among health workers [26-27], therefore adequate personal protective equipment (PPE) is necessary for healthcare providers [11, 28]. Some barrier enclosure devices such as an Intubation box (I-Box) were used during tracheal intubation [5, 7, 22].

Though the I-Box is a protective device, its utility and performance have been questioned. some studies were shown that intubation may be difficult using the I-Box [29]. So, the current study aimed to evaluate the endotracheal intubation outcomes with and without an I-Box in COVID-19 patients.

Our findings showed that intubation outcomes were better in the without I-Box group than in the I-Box group. The duration of intubation was significantly longer in the I-box group than without the I-box group. In without I-box group, all patients were successfully intubated in the first attempt, while in the I-box group, the intubation was successful in the first attempt in half of the patients. The visibility of the airway was significantly better in the without I-box group than the I-box group and the number of attempts for successful intubation was higher in the I-box group. In the I-Box group, more patients needed optimizing maneuver of the airway.

The impact of I-Box on intubation during COVID-19 has been investigated in a few studies [17, 22, 25, 29-32]. Consistent with the current study, in some studies, it has been shown that using a box makes intubation time longer [17, 22, 25, 30]. while in a study by Venketeswaran et al was shown that the intubation time was not significantly different between three different designated aerosol boxes [31].

In the current study was shown that using the I-Box decreases significantly the rate of successful intubation in the first attempt and increases the number of attempts for successful intubation compared to without the I-Box group. Therefore, in this study, the rate of first intubation success was 100% and 50% in with and without I-box groups respectively. Azhar et al reported that the first-pass intubation success rate was 94.4% and 100% with and without the aerosol box [22].

This study showed the visibility of the airway was significantly better in the without I-box group than in the I-box group, which reduced the number of successful intubation attempts in patients with covid-19. Consistent with the current study, previous studies showed that visibility reduce when intubating with the aerosol box [22, 30]. Turner et al reported that intubation was significantly more difficult using an aerosol box [33].

Protecting and reducing exposure of healthcare workers in high-risk procedures such as endoscopy, and endotracheal tube intubation from possible infection is necessary, However, as much as possible personal protective equipment must be used to provide ease of endotracheal intubation and safety of COVID-19 patients.

Conclusion

In conclusion, the use of an Intubation box significantly increased intubation time and the number of attempts for successful intubation. It reduced significantly the rate of first-pass success intubation and visibility.

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References

[1] Lie SA, Wong SW, Wong LT, Wong TGL, Chong SY. Practical considerations for performing regional anesthesia: lessons learned from the COVID-19 pandemic. Can J Anaesth. 2020; 67(7):885-92.
[2] Zhong B-L, Luo W, Li H-M, Zhang Q-Q, Liu X-G, Li W-T, et al. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. Int J Biol Sci. 2020; 16(10):1745-52.
[3] Bianco F, Incollingo P, Grossi U, Gallo G.

Preventing transmission among operating room staff during COVID-19 pandemic: the role of the Aerosol Box and other personal protective equipment. Updates Surg. 2020; 72:907-10.

[4] Organization WH. COVID-19 weekly epidemiological update, 23 February 2021. 2021.

[5] Weissman DN, De Perio MA, Radonovich LJ. COVID-19 and risks posed to personnel during endotracheal intubation. Jama. 2020; 323(20):2027-8.

[6] Givi B, Schiff BA, Chinn SB, Clayburgh D, Iyer NG, Jalisi S, et al. Safety recommendations for evaluation and surgery of the head and neck during the COVID-19 pandemic. JAMA Otolaryngol Head Neck Surg. 2020; 146(6):579-84.

[7] Ljubicic N, Stojsavljevic-Shapeski S, Virovic-Jukic L, Nikolic M. Plexiglas barrier box to improve ERCP safety during the COVID-19 pandemic. Gastrointest Endosc. 2020; 92:428-9.

[8] Cook T, El-Boghdadly K, McGuire B, McNarry A, Patel A, Higgs A. Consensus guidelines for managing the airway in patients with COVID-19: Guidelines from the Difficult Airway Society, the Association of Anaesthetists the Intensive Care Society, the Faculty of Intensive Care Medicine and the Royal College of Anaesthetists. Anaesthesia. 2020; 75(6):785-99.

[9] Brown H, Preston D, Bhoja R. Thinking outside the box: a low-cost and pragmatic alternative to aerosol boxes for endotracheal intubation of COVID-19 patients. Anesthesiology. 2020; 133(3):683-684.

[10] Zahid K, Ahmed ALD, Hesam Aldin V, Parsa M, Mostafa M. Early versus delayed intubation and technique in COVID-19. Arch Anesth & Crit Care. 2022; 8(1):60-67.

[11] Yang SS, Zhang M, Chong JJ. Comparison of three tracheal intubation methods for reducing droplet spread for use in COVID-19 patients. Br J Anaesth. 2020; 125(1):e190-e191.

[12] Cordier PY, De La Villeon B, Martin E, Goudard Y, Haen P. Health workers' safety during tracheostomy in COVID-19 patients: Homemade protective screen. Head Neck. 2020; 42(7):1361-1362.

[13] Luo M, Cao S, Wei L, Tang R, Hong S, Liu R, et al. Precautions for intubating patients with COVID-19. Anesthesiology. 2020; 132(6):1616-1618.

[14] Lin L-W, Hung T-Y. Swivel-HEPA-ETT (SHE) bougie and HEPA-ETT (HE) methods for safe intubation while managing patients with COVID-19. Emerg Med J. 2020; 37(5):256-7.

[15] Yang Y-L, Huang C-H, Luk H-N, Tsai PB. Adaptation to the plastic barrier sheet to facilitate intubation during the COVID-19 pandemic. Anesth Analg. 2020; 131(2):e97-e99.

[16] Moraga FAL, Moraga EL, Moraga FL, González AJ, Celaya JMI, Gallegos JAO, et al. Aerosol box, an operating room security measure in COVID-19 pandemic. World J Surg. 2020; 44(7):2049-50.

[17] Begley J, Lavery K, Nickson C, Brewster D. The aerosol box for intubation in coronavirus disease 2019 patients: an in-situ simulation crossover study. Anaesthesia. 2020; 75(8):1014-21.

[18] Jazuli F, Bilic M, Hanel E, Ha M, Hassall K, Trotter BG. Endotracheal intubation with barrier protection. Emerg Med J. 2020; 37(7):398-9.

[19] Dalli J, Khan MF, Marsh B, Nolan K, Cahill RA. Evaluating intubation boxes for airway management. Br J Anaesth. 2020; 125(3):e293-e295.

[20] Brown S, Patrao F, Verma S, Lean A, Flack S, Polaner D. Barrier system for airway management of COVID-19 patients. Anesth Analg. 2020; 131(1):e34-e35.

[21] Girgis AM, Aziz MN, Gopesh TC, Friend J, Grant AM, Sandubrae JA, et al. Novel coronavirus disease 2019 (COVID-19) aerosolization box: Design modifications for patient safety. J Cardiothorac Vasc Anesth. 2020; 34(8):2274-6.

[22] Azhar MN, Bustam A, Poh K, Zahedi AZA, Nazri MZAM, Ariffin MAA, et al. COVID-19 aerosol box as protection from droplet and aerosol contaminations in healthcare workers performing airway intubation: a randomised cross-over simulation study. Emerg Med J. 2021; 38(2):111-7.

[23] Clariot S, Dumain G, Gauci E, Langeron O, Levesque É. Minimising COVID-19 exposure during tracheal intubation by using a transparent plastic box: A randomised prospective simulation study. Anaesth Crit Care Pain Med. 2020; 39(4):461-3.

[24] Laack TA, Pollok F, Sandefur BJ, Mullan AF, Russi CS, Yalamuri SM. Barrier Enclosure for Endotracheal Intubation in a Simulated COVID-19 Scenario: A Crossover Study. West J Emerg Med. 2020; 21(5):1080.

[25] Feldman O, Samuel N, Kvatinsky N, Idelman R, Diamand R, Shavit I. Endotracheal intubation of COVID-19 patients by paramedics using a box barrier: A randomized crossover manikin study. PloS one. 2021; 16(3):e0248383.

[26] Vijayaraghavan S, Puthenveettil N. Aerosol box for protection during airway manipulation in covid-19 patients. Indian J Anaesth. 2020; 64(Suppl 2):S148.

[27] Malik J, Jenner C, Ward P. Maximising application of the aerosol box in protecting healthcare workers during the COVID-19 pandemic. Anaesthesia. 2020; 75(7):974-975.

[28] Simpson J, Wong D, Verco L, Carter R, Dzidowski M, Chan P. Measurement of airborne particle exposure during simulated tracheal intubation using various proposed aerosol containment devices during the COVID-19 pandemic. Anaesthesia. 2020; 75(12):1587-95.

[29] Mahmudiono T, Singhal S, Mohammad AA, Failoc-Rojas VE, Catalan Opulencia MJ, Haro AS, et al. The impact of aerosol box on tracheal intubation during the COVID-19 pandemic: a systematic review. Expert Rev Med Devices. 2022; 19(10):779-

789.
[30] Fong S, Li E, Violato E, Reid A, Gu Y. Impact of aerosol box on intubation during COVID-19: a simulation study of normal and difficult airways. Can J Anaesth. 2021; 68(4):496-504.
[31] Venketeswaran MV, Srinivasaraghavan N, Balakrishnan K, Seshadri RA, Sriman S. Intubation outcomes using the aerosol box during the COVID-19 pandemic: A prospective, observational study. Indian J Anaesth. 2021; 65(3):221-228.
[32] Lim ZJ, Reddy MP, Karalapillai D, Shekar K, Subramaniam A. Impact of an aerosol box on time to tracheal intubation: systematic review and meta-analysis. Br J Anaesth. 2021; 126(3):e122-e125.
[33] Turner JS, Falvo LE, Ahmed RA, Ellender TJ, Corson-Knowles D, Bona AM, et al. Effect of an aerosol box on intubation in simulated emergency department airways: A randomized crossover study. West J Emerg Med. 2020; 21(6):78-82.